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GROWING AND HANDLING GARLIC
IN CALIFORNIA

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GROWING AND HANDLING GARLIC IN CALIFORNIA

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Garlic production is being tested in many new localities in California, and there has been a considerable demand for information on this crop. The use of fresh garlic for seasoning has become general. Garlic is also used to some extent as a constituent of salads. Garlic salt, the pulverized dehydrated cloves, is now being manufactured for the same purpose. The quantity of garlic used per capita is fairly constant. Most fruits and

TABLE 1
GARLIC IMPORTS INTO THE UNITED STATES, 1925-1932*

Year	Spain	Chile	Mexico	Italy	Germany	Other countries	Total
In thousands of pounds							
1925.....	2,390	1,306	1,094	657	0	341	5,788
1926.....	2,926	238	477	456	1	28	4,126
1927.....	1,726	463	263	404	44	52	2,952
1928.....	2,240	1,059	554	1,736	332	258	6,179
1929.....	1,591	1,323	1,082	350	135	21	4,502
1930.....	1,599	1,417	1,520	69	20	71	4,696
1931.....	2,461	596	1,460	676	425	39	5,657
1932.....	2,342	1,836	1,476	805	76	29	6,564

* Compiled from: U. S. Dept. Com. Foreign Commerce and Navigation of the United States.

vegetables are purchased more liberally when they are cheap, but this is not true of garlic. Oversupplies are not easily absorbed, consequently overproduction is easily accomplished.

GARLIC PRODUCTION IN FOREIGN COUNTRIES

Garlic seems to have been well known to the ancients, being mentioned often in early writings. At present it is cultivated in practically all countries. In India, China, the Mediterranean countries, Mexico, and South America it is probably cultivated to a greater extent than elsewhere. Garlic is imported into the United States from a number of foreign countries. The five countries leading in exports to the United States for the years 1925 to 1932 are given in table 1.

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PRODUCTION AREAS IN THE UNITED STATES

Garlic is grown to a limited extent in a number of localities in the United States, particularly in the South and on the Pacific Coast. The principal producing states are California, Texas, Louisiana, and Arkansas—the first two being the most important. The Bureau of Agricultural Economics of the United States Department of Agriculture gives the garlic acreage in Texas from 1930 to 1933 as 1,200; 1,000; 2,200; and 1,850. In Texas planting is done from November to January and harvesting from June to August. In Louisiana most of the garlic is produced in the southern half of the state. Planting is usually done in October and November and the crop harvested during the month of May.

TABLE 2
GARLIC ACREAGE IN CALIFORNIA BY COUNTIES, 1929–1932*

District	Acreage			
	1929	1930	1931	1932
Alameda.....	75	75	80	50
Contra Costa.....	25	25	30	30
Monterey.....	150	280	70	70
San Benito.....	1,300	1,800	1,500	1,150
Santa Clara.....	400	700	400	250
Santa Cruz.....	175	70	170	150
Merced.....	70	50	50	70
Riverside, and others.....	30	30	30	30
Total.....	2,225	3,030	2,330	1,800

* Data from California Cooperative Crop Reporting Service, Sacramento.

PRODUCTION AREAS IN CALIFORNIA

During recent years, California has been the leading garlic-producing state. The crop is grown chiefly in the area about Hollister, San Juan, and Salinas, although small plantings are recorded in Alameda, Contra Costa, Santa Clara, Santa Cruz, Merced, and Riverside counties. Estimates of the acreage planted from 1929 to 1932 are given in table 2.

CLIMATIC REQUIREMENTS

In California, garlic seems to do best in those districts where the summer and winter temperatures are moderated somewhat by ocean breezes.

The crop is planted in the late fall, after the first rains have fallen, and it is harvested during the following June or July. In central California, where most of the crop is produced, the plants grow throughout

the winter; while the top growth may not be extensive, a good root system is being developed. So far as is known, frosts have never severely injured the plants in the main garlic-growing districts. During the winter of 1932-33, however, considerable damage was done to the crop in Texas. The tops were killed to the ground, and although the plants recovered somewhat, the stand was reduced about 25 per cent. High summer temperatures do not injure the plants while they are still in the ground. After digging, however, the bulb is easily sunburned and must therefore be well protected. This is particularly true of Early garlic; Late garlic is much more resistant to sunburn.

SOIL REQUIREMENTS

Garlic is produced on a wide range of soils, but it seems to make a more uniform growth and develop a smoother and larger bulb on the medium loams or clay loams. Heavy adobe soils or clay soils are usually unsatisfactory because they tend to prevent the equal expansion of the bulb, resulting in irregular shapes and rough surfaces, which are objectionable to the trade. On heavy soils, it is difficult to get the horizontal cutter blade deep enough in the soil, at the time of harvest, to loosen the bulbs without injuring them. Heavy soils become dry and hard at harvest time, and during cutting and pulling the bulbs are often badly broken and bruised. These injuries permit the development of rot and a rapid deterioration of the bulb in storage.

Garlic is seldom raised on light sandy soils, because they do not have a sufficient moisture-holding capacity to mature the crop without irrigation; and as discussed later in this circular, irrigation is avoided whenever possible.

Wet soils produce good garlic bulbs, but it is asserted by certain growers that they do not keep well in storage. Wet soils also have a tendency to produce discolored bulbs, which are not acceptable to the trade. Garlic is not alkali tolerant, and soils that contain high concentrations should be avoided.

PREPARATION OF THE LAND FOR PLANTING

Preparation of the seed bed is one of the most important operations in the production of garlic. It is essential that the ground be plowed deeply and well pulverized before the crop is planted. Most growers prefer to plow the soil when it is dry. After the soil is well prepared, the field is marked by using a cultivator with the chisels set 19 inches apart. This marking should form furrows about 2 inches deep. Experience has shown that a 19-inch spacing between rows is best for the method of

cultivation now being used; when spaced 18 inches apart they are too close, and when spaced farther apart there is a waste of land. Land preparation, including plowing, preparation of the seed bed, and marking, usually costs about \$8.00 per acre.

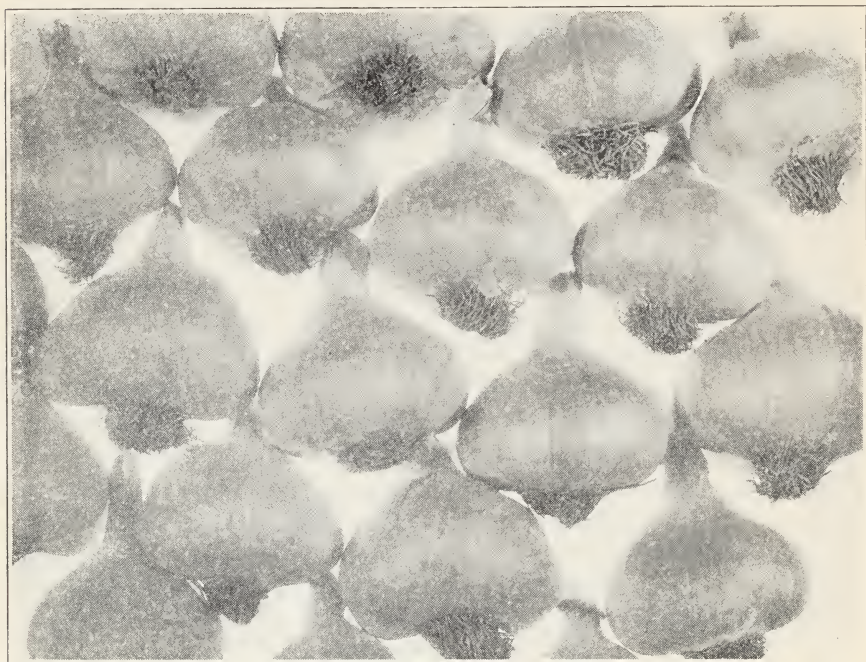


Fig. 1.—Good-type bulbs of Late garlic.

VARIETIES

Two types of garlic are commonly grown in California: the variety known as Early (also called White or Mexican); and the variety Late (also called Pink or Italian) (fig. 1). The flat leaves of the Early garlic are somewhat broader than those of the Late. It is more susceptible to sunburn, having fewer protecting wrapper leaves. It is a heavier yielder, seems to be resistant to stem nematode, and is harvested from two to three weeks earlier than the Late variety; but it does not keep so well in storage. Yields of Early garlic usually range from 5,000 to 9,000 pounds per acre, while those of Late garlic usually vary from 4,000 to 7,500 pounds.

PLANTING

The garlic bulb is composed of a large number of cloves enclosed by several scales. The bulbs are broken by hand just before planting. The outer scales are removed, the cloves separated (fig. 2), those that are

desirable removed, and the trash blown out. All the cloves are planted, except the long slender ones that are found in the center of the bulb. The cost of preparing the cloves for planting is usually about fifty to sixty cents for a hundred pounds. Planting stock should be selected that is free from stem nematode and pink root. Bulbs that have side growths should be discarded.

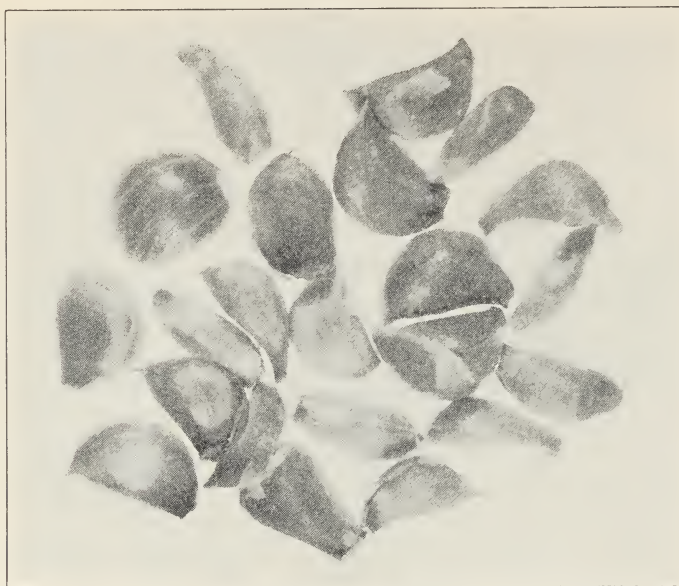


Fig. 2.—Cloves from a single bulb of Early garlic, ready for planting.

In the garlic districts of central California, planting is done in the late fall after the first rains have fallen, usually in December. At present, the cloves are planted by hand, 3 to 4 inches apart in the row. They are set into the soil in an upright position, deep enough to hold them erect, and have the top of the cloves just below the top of the furrow. The cloves are seldom covered. It takes one man about six days to plant an acre by hand. From 600 to 700 pounds of bulbs are required to plant an acre, the amount depending upon the size of the bulbs.

IRRIGATION

Garlic is a rather deep-rooted plant and on the heavier soils, in the coastal valleys, will usually mature without irrigation. Irrigated garlic frequently develops side shoots and stiff necks; and it is also the general belief that it will not keep so well in transit and storage. On the other hand, garlic should not be allowed to suffer from lack of moisture during the growing season. If the moisture is deficient, the development of the

bulb is checked temporarily and subsequent irrigation causes the partly developed cloves to form tops. When water is necessary, it should be applied early in the growing season. In the interior valleys, it is almost always necessary to make several applications of water in order to secure a satisfactory crop. The furrow system is used, the water being applied between the rows.

CULTIVATION

Garlic should not be cultivated until after it has started to grow. A one-horse cultivator is then used to break the crust and kill the weeds. The crop is usually worked four or five times before harvesting. A

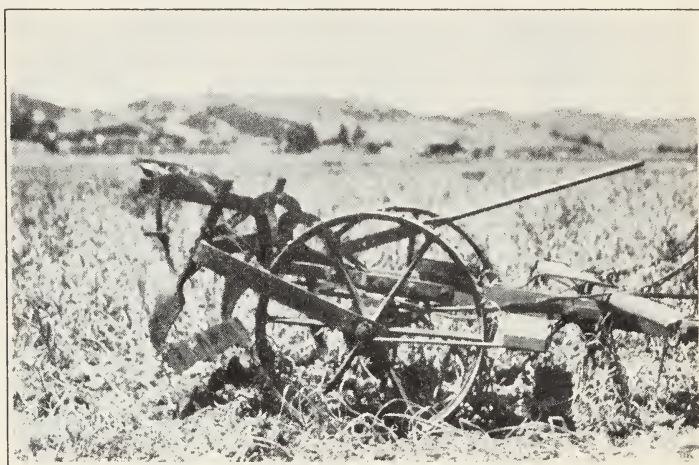


Fig. 3.—Implement used to cut garlic at the time of harvest.

harrow-tooth cultivator is used for the first time over, after which a spike-tooth implement is commonly used. A man and horse can cover about three acres a day.

Garlic is usually hoed once or twice to remove the weeds in the rows. Sometimes the first hoeing after planting is replaced by a cross harrowing in order to reduce the amount of hand labor. This is done only when the soil is left rough after planting, and is delayed until the plants are well rooted. The time required to hoe an acre is about three days, depending upon the amount of weed growth and the type of soil.

HARVESTING

In central California garlic harvesting begins when the tops dry. For the Early garlic, this takes place the latter part of June; and for Late garlic, about the middle of July. A special cutter is used to loosen the plants in the soil. This device consists of a horizontal cutter bar (fig. 3)

designed to pass under two rows at a time. After cutting, the garlic is pulled out of the soil and placed in small bunches in windrows (figs.



Fig. 4.—Lifting and placing garlic that has been cut, in windrows.

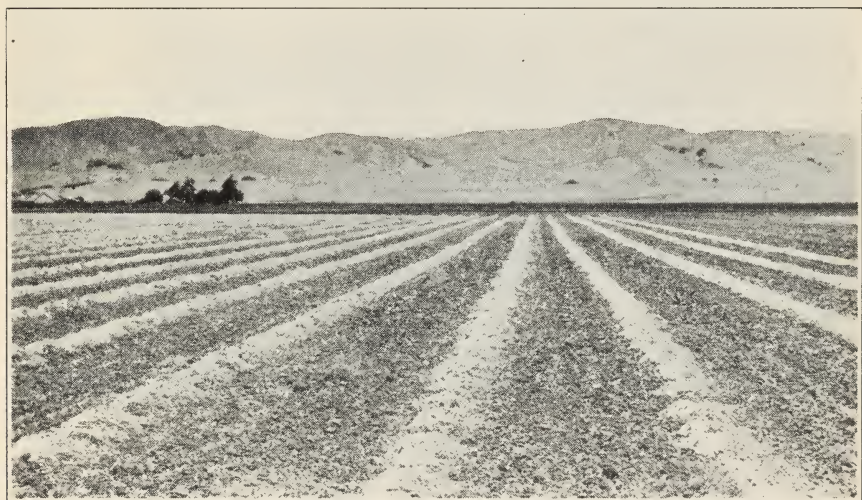


Fig. 5.—After cutting, garlic is laid in windrows for a short time before placing in piles as shown in figure 6.

4 and 5) and then as soon as possible it is removed to a central location in the field where it is stacked in piles (fig. 6). The garlic is left in these

piles for about a week to cure, then it is trimmed by hand (fig. 7) with sheep shears. The roots are cut about $\frac{1}{2}$ inch below the bulb and the tops about 1 inch above the bulb (fig. 1). After trimming, the garlic is stacked in large piles in the field (fig. 8) and allowed to cure for about



Fig. 6.—From the windrows, garlic is hauled by wagon or sled and placed in piles to cure.



Fig. 7.—When dry, the tops and roots are clipped off and the bulbs placed in piles in the field.

10 to 14 days according to weather conditions. To protect the trimmed bulbs from sunburn, most growers cover the piles with the garlic tops.

After the garlic is cured, it is then graded either in the field (fig. 9) or in the warehouse (fig. 10) to remove all the clods, doubles, bulbs less than $1\frac{1}{4}$ inches in diameter, and those having mechanical injuries or

broken skins. The field grader is a simple contrivance consisting of a sloping table made of slats with a spacing of $1\frac{1}{4}$ inches between the slats. The table narrows at the lower end until the opening is small enough to fit the top of the garlic sack.

Most of the garlic in California is harvested by contract, the price depending on the prevailing wages, ranging from about \$14.00 to \$25.00 per acre. This includes pulling, piling, trimming, and grading.



Fig. 8.—Trimming and sacking garlic in the field.

In the southern states, the garlic tops are left on the bulbs and these are braided into strings of 50 bulbs each, known as single strings. Then two single strings are joined to form the double string of 100 bulbs, in which condition it is delivered to the trade.

STORING

Garlic is usually sold in 50 or 100-pound bags. Open-mesh bags are generally used to provide for proper ventilation. Garlic may be kept in a warehouse until January, but if it is to be held later than this it should be placed in cold storage. In the warehouse, the sacks of garlic should not be stacked like grain, but they should be stood on end and the layers placed one sack deep. When stored more than one layer deep, a framework or "deck" is built for each layer (fig. 11). This method of storing facilitates aeration and prevents bruising. When shipped in cars, decks are built to prevent the weight of the upper sacks from injuring the garlic in the lower (fig. 12).



Fig. 9.—Grading garlic bulbs in the field. Note the open-mesh type of bag in general use.

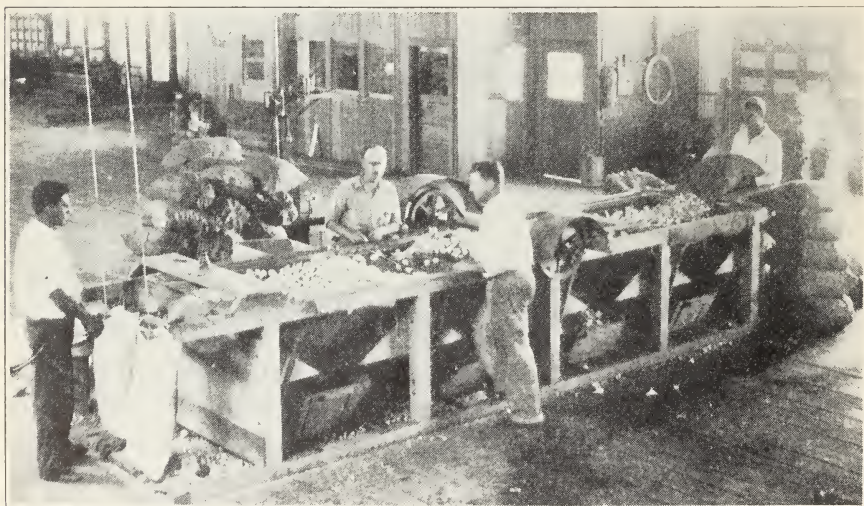


Fig. 10.—A mechanical grader used in the warehouse.

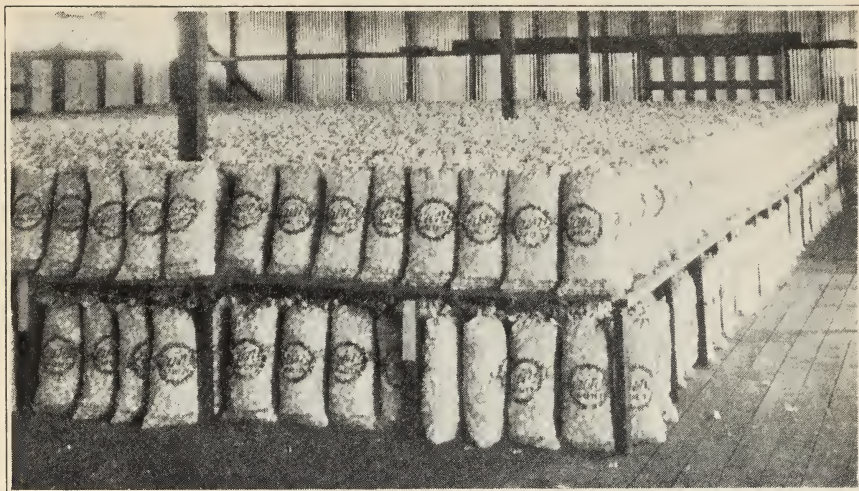


Fig. 11.—Late garlic is stored in the warehouse in open-mesh sacks. Good ventilation is secured by storing in layers.

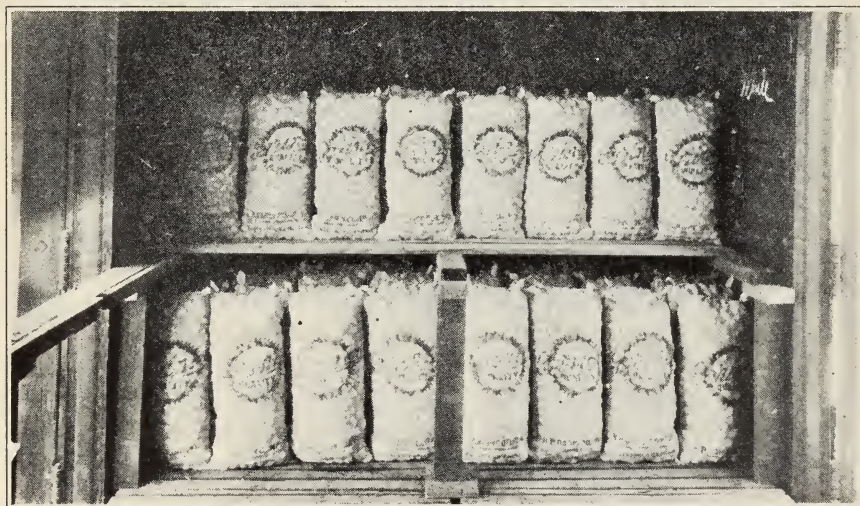


Fig. 12.—For shipping, Late garlic is placed in well-ventilated refrigerator cars.

STANDARDS

Garlic is usually sold under the standards provided by the United States Department of Agriculture. These grades are as follows:

U. S. No. 1 shall consist of garlic of similar varietal characteristics which is matured and well cured, clean, compact, with cloves well filled and fairly plump, and free from damage caused by doubles, sunburn, sunscald, cuts, tops, roots, disease, insects, or mechanical or other means.

Unless otherwise specified, the minimum diameter of each bulb shall not be less than $1\frac{1}{2}$ inches.

In order to allow for variation incident to proper grading and handling, not more than 10 per cent by weight, of any lot may be below the requirements of this grade, but not more than a total of one-fifth of this tolerance, or 2 per cent, shall be allowed for garlic which is affected by soft rot.

Unclassified shall consist of garlic which is not graded in conformity with the foregoing grade.

Definitions of terms, as used in these grades:

1. "Similar varietal characteristics," means that the garlic in any container is of the same color. White and red garlic shall not be mixed.

2. "Mature and well cured," means having reached that stage of development at which garlic is firm and sufficiently dried so as not to be soft and spongy.

3. "Clean," means free from excessive dirt or other foreign matter.

4. "Compact," means that the cloves are closely joined at the top and are not spreading or split.

5. "Well filled and fairly plump," means that each clove contains a kernel which is fairly plump and not shriveled.

6. "Damage," means any injury or defect which materially affects the appearance of the lot. "Doubles," means garlic consisting of cloves attached to the rest of the bulb at the roots, but which are not enclosed by a scale completely covering the bulb. "Sunburn," means discoloration due to exposure to the sun when there is no injury to the tissue. "Sunscald," means softening of the tissue due to exposure to the sun.

7. "Diameter," means the greatest dimension at right angles to a straight line running from stem to root end.

8. "Soft rot," means any soft or mushy condition of the tissue such as slimy soft rot, or wet breakdown following sunscald.

DISEASES AND PESTS

Red Spider.—During some years the red spider becomes a serious pest in garlic fields. Control is secured by dusting with sulfur. In the past the common practice was to use a power blower, but more recently most of the dusting has been done by airplane. The latter method has given satisfactory results, and has the advantage of covering a large area in a short time. The amount of sulfur used, however, for airplane dusting is from 60 to 100 pounds to the acre while with the power blower only 40 to 60 pounds is used.

Thrips.—The onion thrips, *Thrips tabaci*, is a common pest of garlic. Its habits and nature of injury are the same on this crop as on onions. The feeding of the adults and larvae by sucking the plant sap from the tender leaves in the crown or growing point results in a "silvering" and later a withering of the older leaves. The habit of these minute, winged, grayish-brown adult insects and pale-yellow larvae of hiding in the angles of the leaves of the garlic and on the leaves and flowers of many weeds makes control measures difficult. Clean culture, particularly at

the margins of the field, should be strictly practiced. As soon as the thrips appear in the garlic fields, about the time the grass and weeds begin to dry up in the late spring, control measures should begin. A spray of 1 part of 40 per cent nicotine sulfate to 800 parts of water at 200–250 pounds pressure, or a 5–10 per cent nicotine dust, is recom-



Fig. 13.—Garlic plants of the Late variety killed by the stem nematode.

mended. Thorough coverage is essential and several applications about a week apart are necessary since there are eggs in the leaf tissue and pupae in the ground which cannot be reached. At the time of harvest, all tops, culls, and refuse should be destroyed or removed.

Nematodes.—The alfalfa stem nematode has become a pest on garlic fields in some sections of the state. The Late variety of garlic is very susceptible. Early garlic seems to be resistant, so where infestations occur in the field, it is best to plant only the Early variety. Where the stem nematode has become established in the field, the planting of Late garlic must be abandoned. Care should be taken in the selection of planting stock, to be sure that it is nematode free. The nematode causes the entire bulb to decompose (fig. 13), and in those parts of the field that are infested practically all the plants of Late garlic are destroyed before

they mature. The nematode-infested areas in the field are usually small at first, gradually enlarging as the nematode spreads. Irrigation seems to increase the rapidity of spread somewhat.

Pink Root.—Pink root, a common disease of onions, also attacks garlic. The disease can be identified in the field by the pink color of the roots. The plants are stunted, the bulbs formed are usually small, and the yields are reduced. No means of controlling this disease is known except to avoid infested soil and keep the plants growing at all times.

ACKNOWLEDGMENTS

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